Universitas Pertamina

ECADIN

Proceedings of the

International Symposium

The Role of Blue Carbon in REDD+ and NDC

Jakarta, 19 December 2022 **(Hybrid Mode)**

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Introduction

Currently, the role of blue carbon in climate change mitigation and adaptation is becoming an international prominence. Extensive blue carbon studies are supporting the policymakers in clarifying the role and value of coastal resources in carbon sequestration and provide nature-based solutions to climate change challenges. To promote knowledge and experience sharing on blue carbon science and policy, as well as to facilitate international cooperation; in this regard under the Blue Carbon Initiative by Pertamina Foundation, the 2022 International Symposium of Blue Carbon will be held in December 2022, organized by Universitas Pertamina and Pertamina Foundation as our contribution and commitment in supporting Pertamina's Net Zero Emission Program by 2060.

Coping up with the recent event, the 27th Conference of the Parties to the United Nations Framework Convention on Climate Change - COP27 - builds on the outcomes of COP26 to deliver action on a wide range of issues critical to addressing the climate emergency, including urgently reducing greenhouse gas emissions, building resilience, and adapting to the unavoidable effects of climate change, as well as delivering on commitments to finance climate action in developing countries. Dealing with an intensifying energy crisis, record greenhouse gas concentrations, and an increase in extreme weather events, the COP27 seeks continued international cooperation to deliver on the historic Paris Agreement for people and the planet. Two out of the six themes that was discussed in COP27 are the Net Zero and Biodiversity.

In terms of the key issue of the Net Zero, to ensure commitments are turned into action, the UN Secretary-General António Guterres in March 2022 established a High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities. The Expert Group presented ten recommendations at COP27 on 8 November 2022, and one of them is the relation between People and Nature in the Just Transition. Deforestation driven by land-use change and agriculture contributes around 11% of annual global greenhouse gas emissions, according to the IPCC, reducing the effectiveness of existing carbon sinks. This means the world cannot reach net zero by 2050 without ending deforestation by 2025. Non-state actors involved in the forest, land and agriculture sectors are critical to both the global efforts to reach net zero and protecting and restoring nature. Scientific data points to the need to protect at least 30% of the natural world by 2030. But reversing nature loss is no longer just an environmental issue, it is a social and justice issue as well. Healthy ecosystems are critical to achieving broader sustainable development goals and can unlock enormous economic benefits for food, medicine, tourism and quality of life, particularly for the workers, producers and communities dependent on those ecosystems. This recommendation has been taken well up by Pertamina Holding as the leading national company in energy. Businesses should invest in the protection and restoration of ecosystems beyond the emission reductions in their own operations and supply chains to achieve global net zero. This is important considering the systemic financial risks associated with the loss of biodiversity and the exacerbated climate impacts associated with the loss of natural carbon sinks. Contributions may involve payments for ecosystem services, including the purchase and retirement of high-integrity carbon credits, but these credits cannot be used to meet non-state actors' interim decarbonization targets.

In terms of the key issue of Biodiversity from the COP27, it can be stated that climate change is a primary driver of the biodiversity loss. And climate change depends on biodiversity as part of the solution; therefore, the two issues are linked and cannot be separated. Biodiversity is thus essential for limiting climate change. When human activities produce greenhouse gases, around half of the emissions remain in the atmosphere, while the other half is absorbed by the land and ocean. These ecosystems – and the biodiversity they contain – are natural carbon sinks, providing so-called nature-based solutions to climate change. Protecting, managing, and restoring forests, for example, offers roughly two-thirds of the total mitigation potential of all nature-based solutions. Despite massive and ongoing losses, forests still cover more than 30 per cent of the planet's land. Ocean habitats such as seagrasses and mangroves can also sequester carbon dioxide from the atmosphere at rates up to four times higher than terrestrial forests can. Their ability to capture and store carbon make mangroves highly valuable in the fight against climate change. Conserving and restoring natural spaces, both on land and in the water, is essential for limiting carbon emissions and adapting to an already changing climate. About one-third of the greenhouse gas emissions reductions needed in the next decade could be achieved by improving nature's ability to absorb emissions.

Exactly on the natural-based solution, where different ecosystems and the biodiversity they contain are natural carbon sinks; the so-called Blue Carbon, the Coordinating Minister of Maritime Affairs and Investment of Indonesia made a statement at the summit of the Conference of the Parties 27 (COP27) that Indonesia is ready to develop Blue Carbon Ecosystem. In the session of Mainstreaming Investment and Partnership for Blue Carbon Development, the Minister stated that Indonesia is more than ready to develop a blue carbon ecosystem through comprehensive investment with effective partnerships from all stakeholders and integrated financial mechanisms. The minister also stressed the importance of partnerships and investments in blue carbon development. This is because marine and coastal ecosystems are very crucial for the global climate.

In the conjunction of the aforementioned, therefore, themed as the Role of Blue Carbon in REDD+ and NDC for Climate Change Mitigation and Adaptation, the symposium is designed to get together experts, professional, and academes on the study of Blue Carbon to discuss the following topics:
(1) The Role of Blue Carbon in Coastal Ecosystem
(2) The Role of Blue Carbon in Marine Ecosystem
(3) Status and Way Forward of Regional Biodiversity Policy in ASEAN

The event was participated by President Director of Pertamina Foundation Agus Mashud S. Asngari; Director of Operations of Pertamina Foundation Yulius Bulo as the chair and co-chair of Blue Carbon Initiative (BCI) of Pertamina Foundation; ASEAN Centre for Biodiversity; National Research and Innovation Agency (BRIN); Directorate of Coastal and Small Islands Utilization, Ministry of Marine Affairs and Fisheries Republic of Indonesia; School of Biological Sciences, The University of Queensland, Australia; Energy Academy Indonesia (ECADIN); Rector of Universitas Pertamina; and nearly 447 participants were in presence offline and online, including government officials, scholars, and NGO representatives concerning Blue Carbon.

Opening Remarks

On behalf of the Blue Carbon Initiative of Pertamina Foundation and Universitas Pertamina as the host for 2022 International Symposium of the Blue Carbon, Mr. Agus Mashud S. Asngari as the President Director of Pertamina Foundation and Professor Wiratmaja Puja welcome all the presenters and attendees to the symposium. They highlighted that the Blue Carbon Initiative of Pertamina Foundation with the support of Universitas Pertamina is our contribution and commitment in supporting Pertamina's Net Zero Emission Program by 2060, which reflects countries to adapt to the UN COP26 climate change concerns, in order to strengthen the blue carbon science and policy in ASEAN region. It was also underlined that this symposium will gather consensus on the development of blue carbon and promoted international exchanges and cooperation.

The President Director Pertamina Foundation also highlighted that the activities within the Blue Carbon Initiative is one of 15 Initiative Programs of Pertamina Sustainability that focusses on a nature-based solution based on coastal and marine ecosystem to contribute in Pertamina Net Zero Emission Goal. As one of the biggest national companies in Indonesia and energy company in the world, Pertamina had a direct responsibility into several SDGs, especially related to sustainable economic, energy, climate change and biodiversity. carbon sequestration in coastal and marine ecosystems. And Indonesia has one of the largest mangrove areas in the world (1/5 of the world's mangroves) and has the largest annual climate mitigation from blue carbon potential in the world. With one of the biggest offshore operations and marine vessels in Indonesia, it is a reasonable act for Pertamina to give back and be the first mover to grab this massive potential of blue carbon by using coastal and marine conservation as a leverage and win world spotlight in combating climate change. The Blue Carbon Initiative activities are spanning from the Community Development, Climate Action, to the Protection of Biodiversity; underpinning the CCB Framework. With this symposium it is expected that the Blue Carbon Initiatives will gain insights and recommendations, overcoming the challenges, and looking out for potential collaborations in commencing its activities.

Status and Ways Forward of Regional Biodiversity Policy in ASEAN

Mr. Carlo Carlos from the ASEAN Centre of Biodiversity has introduced the richness of the biodiversity in the ASEAN region with its 173,000 km of coastline; where it inhibits 34% of the world's coral reefs, 600 species of hard corals, 1300 reefs-associated fish species, 51 of the world's mangrove species, 23 of the world's seagrass species that made up a coral triangle with 75% of the world's reef-building corals. The marine ecosystem in ASEAN thus has three major benefits such as generating oxygen, supporting livelihood, and providing food and clean water. The ASEN Centre for Biodiversity (ACB) is established in 2005 and facilitates cooperation among the members of the ASEAN and with relevant national organizations on the conservation and sustainable use of biodiversity in the region. Under the auspices of ACB, there are 51 ASEAN Heritage Parks (AHPs) and 9 Marine AHPs, which is covering approx. 1.85M. The

ACB has initiated the ASEAN Green Initiative that Supports national greening initiatives, shares the common aim of increasing tree cover and restoring ecosystems, and encourages the active participation of various sectors. It has a tagline of "at least 10 million native trees across 10 ASEAN Member States in a span of 10 years". In conjunction with the ASEAN Green Initiatives, the ACB develops also the ASEAN Youth Biodiversity Program (AYBP) with main activities such as Youth Biodiversity Leaders, Youth Internships in Protected Areas in ASEAN, and Young ASEAN Storytellers. The ACB has published the ASEAN Biodiversity Outlook 3 which assesses the progress toward biodiversity targets and prospects for transformative change. It sums up the Post-2020 Global Biodiversity Framework with 4 Long-Term Goals (Biodiversity conservation, Sustainable use and management of nature, Access-benefit sharing and traditional knowledge, and Means of implementation); 22 Action Targets for 2030 that include Species conservation, Protected areas, Ecosystems, Pollution reduction, Climate change, and disaster risk reduction, Natural resource management, Access-benefit sharing, Mainstreaming, Businesses, and financial institutions, Sustainable consumption, Biotechnology, Resource mobilization and financing, Gender and IPLCs, and Capacity building and development.

The ACB is strongly supported Nature-Based Solutions and Blue Carbon as stated in the ASEAN Joint Statement to the Fifteenth Meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD CO 15):

- Promoting human well-being through the sustainable use and management of ecosystems for the continued provision of ecosystem services, including through ecosystem-based approaches, nature-based solutions, as well as participatory, indigenous, and community-based conservation practices.
- Strengthen their adaptation efforts by implementing, among others, nature-based solutions and ecosystem-based approaches, focusing on the protection of the livelihoods and fulfillment of basic necessities (water, food, energy, and environmental health) of the vulnerable groups.

The nature-based solutions and blue carbon are as well stated in the document of ASESN State of Climate Change Report – Current Status and Outlook of the ASEAN region Toward the ASEAN Climate Vision 2050:

- Engage relevant sectors and actors (including youth) to highlight the importance of nature-based solutions to prevent future pandemics through cross-sectoral collaboration and multi-stakeholder engagement and as part of ASEAN's agenda on mainstreaming biodiversity across relevant sectors, and to encourage individuals and community to become 'bioliterate' to address the future pandemic.
- Adaptation action: Promote nature-based solutions (NbS) in all priority sectors by 2030: Nature-based solutions are evaluated for their efficacy, NbS are integrated, where feasible, into various adaptation interventions, stakeholders' capacity is improved in Nbs and by 2050: NbS form an important part of adaptation strategy in the region.

Few documents more that mention the importance of nature-based solutions and blue carbon, which are endorsed by the ACB are as follows:

- Guidance for Using the IUCN Global Standard for Nature-based solutions: A user-friendly framework for the verification, design, and scaling up of Nature-based solutions (First edition)
- CBD Technical Series No. 93: Voluntary Guidelines for the Design and Effective Implementation of the Ecosystem-bases Approaches to Climate Change Adaptation and Disaster Risk Reduction and Supplementary Information.

- ASEAN 2025: Forging Ahead Together
- ASEAN Socio-Cultural Community: Blueprint 2026

Above documents can be seen in the figure below.

Figure 1. Various documents on Natural-based Solutions and Blue Carbon, endorsed by the ASEAN Centre for Biodiversity

There are five Ways Forward from ACB on how to proceed with Nature-based Solutions and Blue Carbon:

- Identify the capacity needs of AMS on implementing the post-2020 GBF
- Ensure coherences on policies or strategies to be developed
- Find out the common understanding of Nature-based Solutions – What is it for ASEAN?
- Ensure safeguards in implementing Nature-based Solutions
- Integrate blue carbon in regional policies

Key points from the ASEAN Biodiversity session that could be taken up in moving forward are as follow: Business operations are impacting the natural resources their work on. Therefore, further transparencies on how businesses are trying to restore natural resources should be in place. In the ASEAN state of Climate Change Report, the Natural-based Solution is strongly committed and promoted n all priorities in development as adaptation strategy ASEAN has developed a guidance for using IUCN Global Standards for NBS. We should as well consider foremost for beneficiaries for vulnerable ones, if the Natural-based Solution is applied, we have to ensure that the policies are at hand if implementing the Natural-based Solution. Thus, biodiversity is linking all the natural elements that should be inhibited in the implementation of the Natural-based Solution.

The Role of Blue Carbon in Coastal Ecosystem

Dr. Novi Susetyo Adi from the Directorate of Coastal and Small Islands Utilization, Ministry of Marine Affairs and Fisheries Republic of Indonesia delivered a presentation about the Nature-based and Nature-Climate solutions (NBS/NCS) from the coastal ecosystem perspective. Blue Carbon is defined as biological Carbon captured by coastal-marine organisms through a photosynthetic process. Recently, Blue Carbon has been seen as one of the potential climate change mitigations. The importance of Blue Carbon in climate change mitigation is mainly because, despite its small surface area, Blue Carbon is a major term

in the global marine Carbon cycle. It has the highest Carbon Storage Capacity (C-sequestered) among all types of earth cover.

On the other side from the coastal ecosystem's capacity to sequester carbon, it will actively emit carbon into the atmosphere if destroyed or degraded. Blue carbon is the NbS for climate change mitigations. Several of Dr. Novi notes on the utilization of blue carbon for climate change mitigations are:

a. Rehabilitate & plant mangroves and seagrass
b. NbS as cheaper than negative emission technologies are too expensive to deploy at scale
c. BECCS/Bioenergy CSS may have negative impacts

Dr. Novi introduced the REDD+ scheme as one of the important frameworks to achieve the NDC target, where payment is made based on emission reduction from activities in the forest sector that reduces emissions from deforestation and forest degradation. Mangrove ecosystem have been incorporated into the national GHG Inventory. He introduced a framework as well to optimize the Blue Carbon, incorporating the NDCs, and having the science; policy; and funding as the prerequisite as illustrated in Figure 2 below.

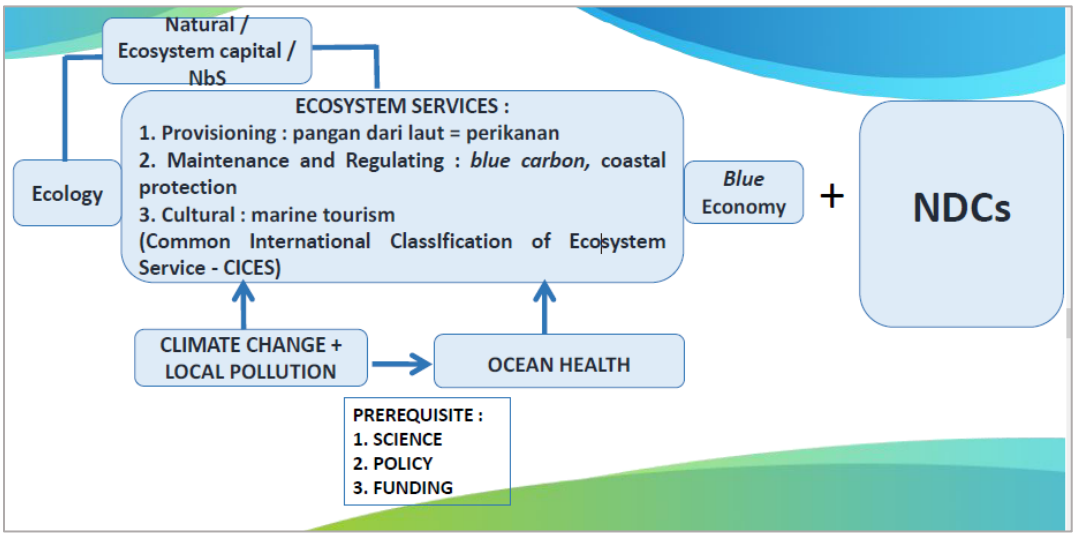


Figure 2. A Framework to optimize Blue Carbon (Adi, 2022)

To underpin the crucial link of Blue Carbon and the NDCs, there is a Decision Tree that is created by Courtney Durham, Tamara Thomas, and Moritz Unger, which was inspired by Nature-based Solutions in Nationally Determined Contributions that was synthesized and recommended for enhancing climate ambition and action by 2020 and published by IUCN and University of Oxford (2020). This Decision Tree is illustrated in Figure 3 below.

Therefore, in the report of Updated Nationally Determined Contribution of Republic Indonesia (2021) it was clear that the strategic approach of Indonesia's NDCs is predicted on the following fundamental principles:

1. Employing a landscape approach. Recognizing that climate change adaptation and mitigation efforts are inherently multi-sectoral in nature, Indonesia takes an integrated, landscape-scale approach covering terrestrial, coastal, and marine ecosystem
2. Highlighting existing best practices. Recognizing significant strides in multi-stakeholder efforts in combating climate change. Indonesia intends to scale up the diversity of traditional wisdom as well as innovative climate change mitigation and adaptation efforts by the government, private sector, and communities.
3. Mainstreaming climate agenda into development and spatial planning and budgeting process, Indonesia includes key climate change that indicators in formulating its development program targets.
4. Promoting climate resilience in food, water, and energy. Recognizing the importance of fulfilling the needs of a growing young population for food, water, and energy. Indonesia will improve its management of natural resources to enhance climate resilience by protecting and restoring key terrestrial, coastal, and marine ecosystems.

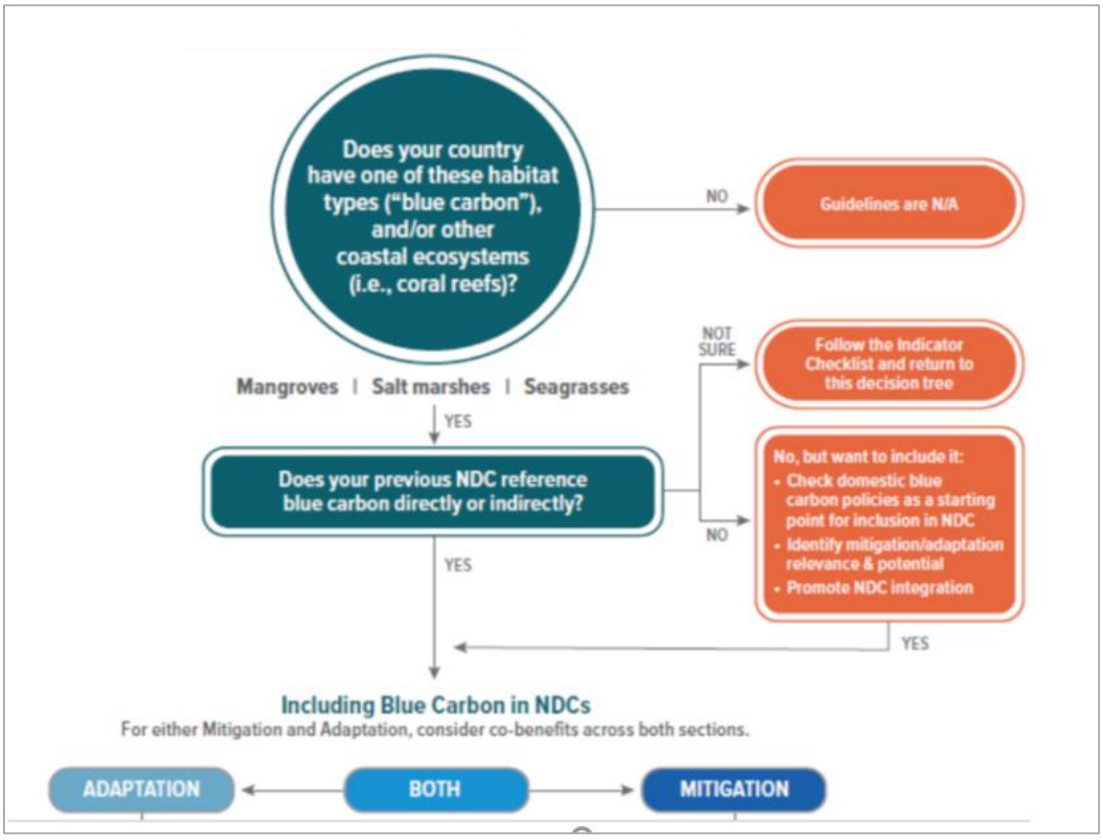


Figure 3. The Decision Tree (IUCN and University of Oxford, 2020)

There are still tasks and duties or homework for Indonesia to take and these are the following:

- For Mangrove Ecosystem:
  a. Identify and Compile of Activity Data on Mangrove BGB

b. Develop a methodology of Soil Carbon (Tier 2) (Data Activity and Emission Factor)

- For Seagrass Ecosystem:
  a. Develop complete map of Indonesian seagrass (i.e., one map of seagrass that cover all Indonesian coastal area and time series)
  b. Identify and Develop an Activity Data and Emission Factor
  c. Finding a 'home sector' to seagrass carbon in NDCs

- Implement *Perpres* (Presidential decree) 98 2021 on Economic Value of Carbon
- Integrating ecosystem services into coastal zone management
- STOP DEGRADATION

Once the seagrass was mentioned in relation to carbon emissions reduction in NDCs, Dr. Aan J Wahyudi from the Agency of National Research and Innovation (BRIN) pinpointed out the carbon-offset potential from tropical seagrass conservation in Indonesia. It was considered as an Ocean-based climate action in terms of mitigation activity of the Conservation/Protection Seagrass Ecosystem on Marine Protected Area. Seagrass ecosystem services maintains marine biodiversity regulating the quality of coastal waters, protecting the coastlines, structuring the ecosystem communities, and sequestering carbon (Costanza et al. 1997; Duarte et al. 2005; Harrould-Kolieb et al. 2010; Cullen-Unsworth and Unsworth 2013; Bala 2014).

Indonesia's seagrass habitat is generally in moderate condition (Hernawan et al., 2021) and based on on ground-truthing validation, only ca. 293,464 ha have been verified up until now (Sjafrie et al. 2018). However, the current areas of Indonesia's seagrass would be within the range of 875,967–1,847,341 ha (Wahyudi et al., 2020). Figure 4 and Figure 5 illustrates the distribution of seagrass in Indonesia and the Absorption/assimilation (sequestration to the biomass) >> stock >> accretion (sequestration to the sediment). In addition to above, the carbon assimilation: atmospheric CO2 to coastal vegetation biomass has been mentioned as well by Dr. Aan J Wahyudi (Figure 6).

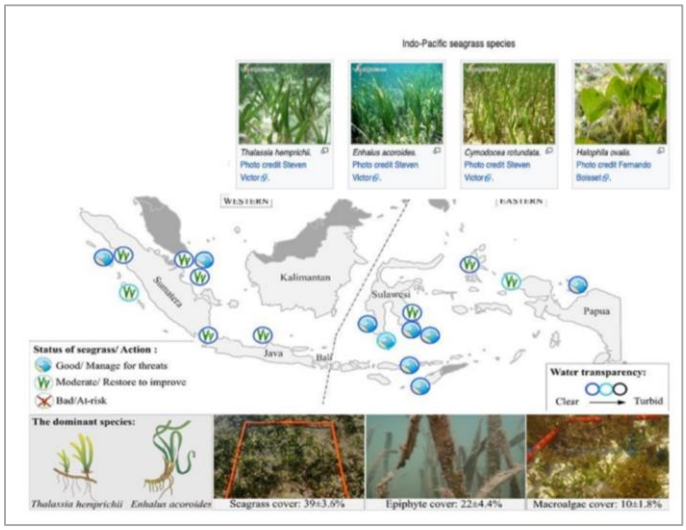


Figure 4. The Distribution of Seagrass in Indonesia (Wahyudi, 2022)

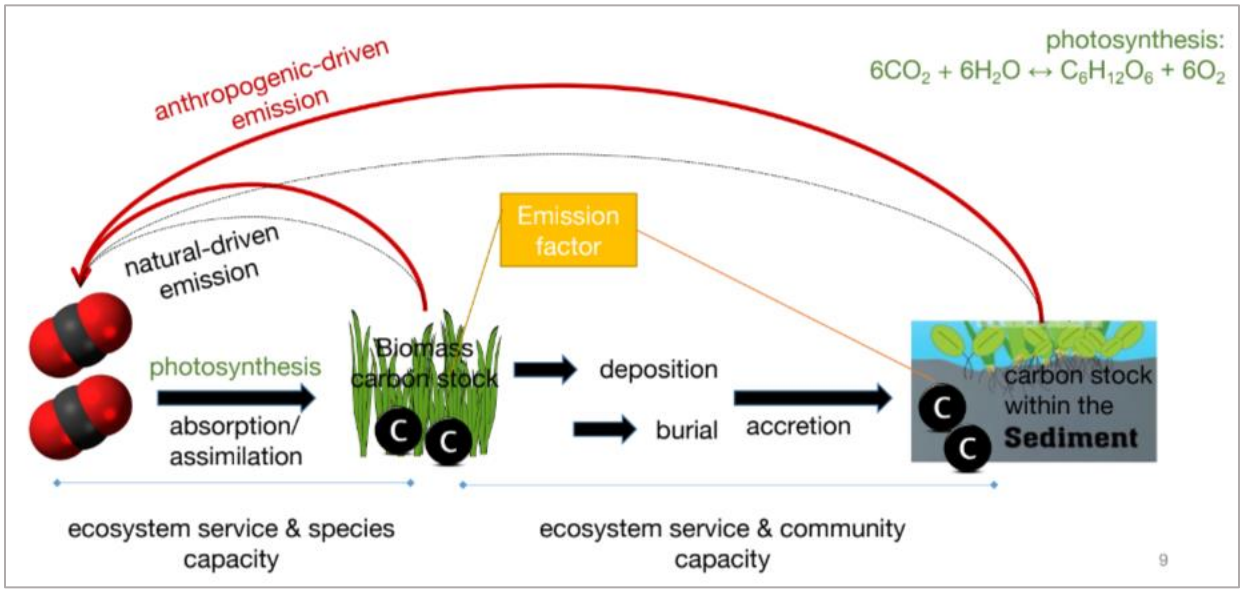


Figure 5. The Absorption/Assimilation (sequestration to the biomass) >> Stock >> Accretion (sequestration to the sediment) (Wahyudi, 2022)

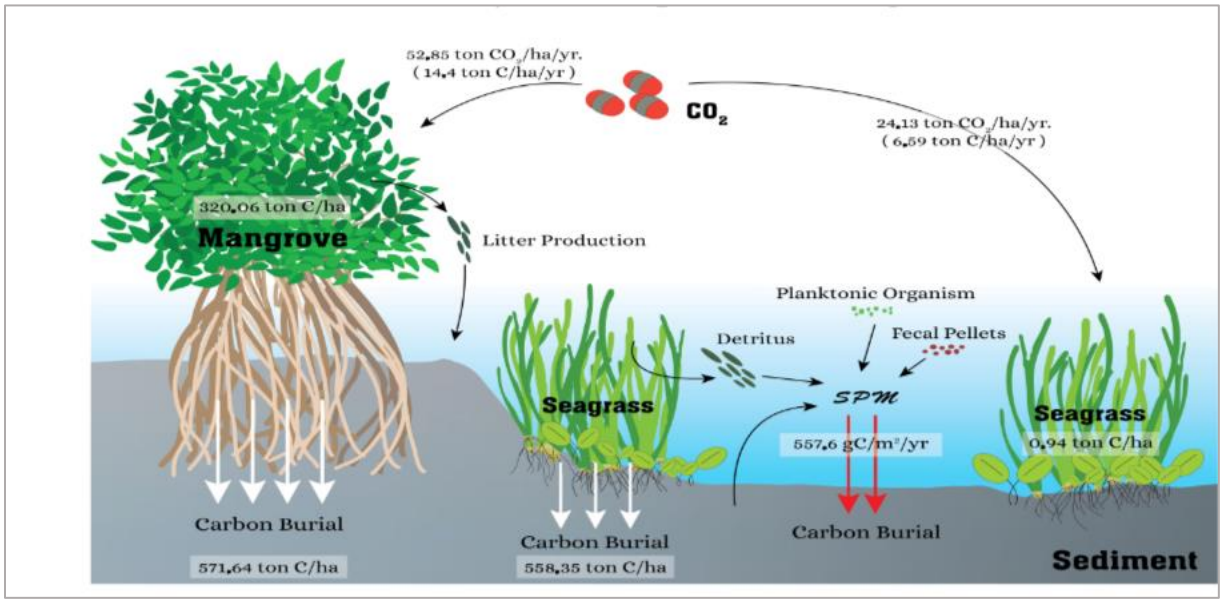
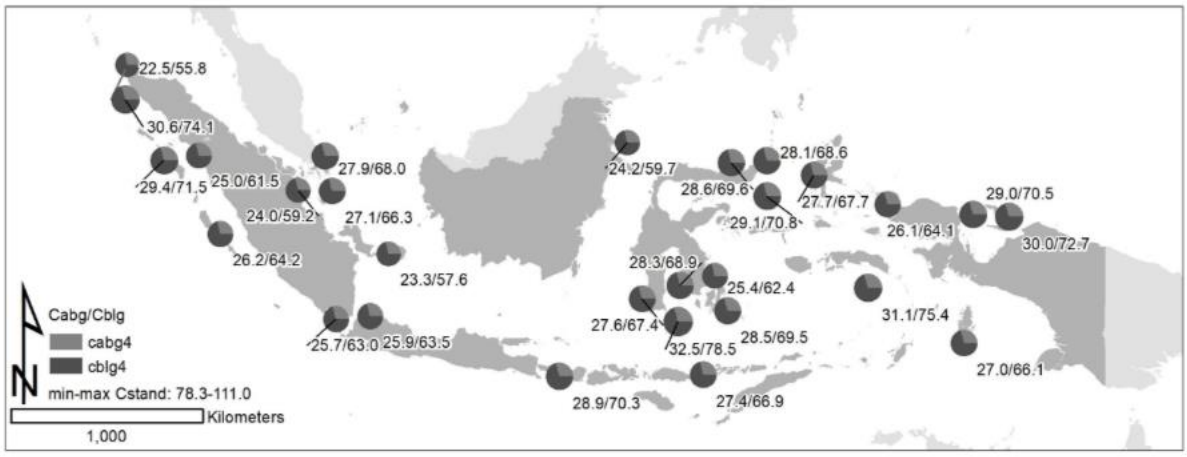
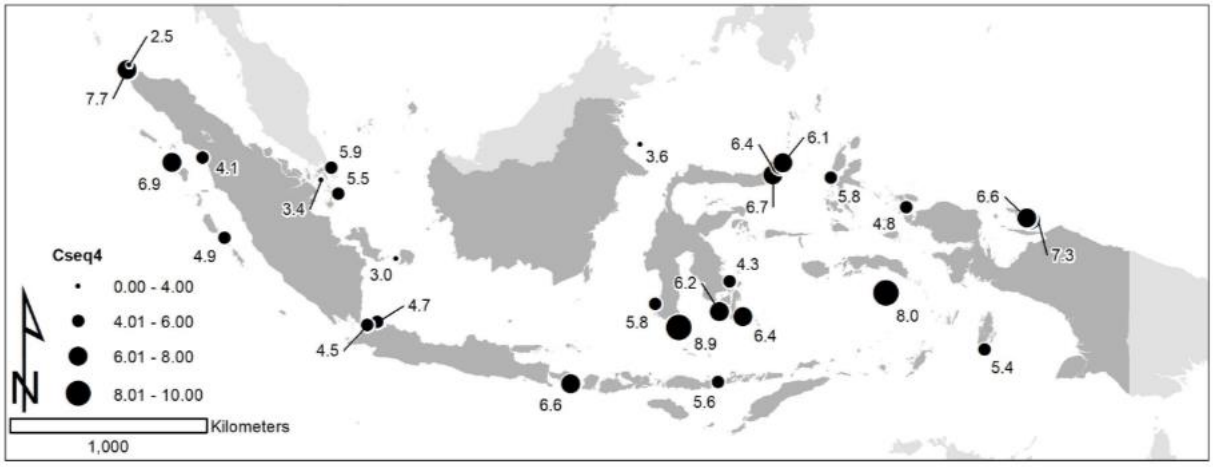


Figure 6. The Carbon Assimilation: Atmospheric CO2 to Coastal Vegetation Biomass (Wahyudi, 2022)

Furthermore, Dr. Aan J. Wahyudi presented the updated data of distribution as well of Indonsia Seagrass Carbon in 2020 as it is illustrated in Figure 7 according to the different ktC.



Above-ground, below-ground, standing stock of seagrass meadows in Indonesia were ca. 8—314 ktC, 276-1,005 ktC (Wahyudi et al., 2020)



Carbon sequestration of seagrass meadows in Indonesia 1.6–7.4 MtC/year (Wahyudi et al. 2020)

Figure 7. Indonesia Seagrass Carbon (updated 2020) (Wahyudi et al., 2020)

There are principles on how to count the carbon stock until reporting to the NDC:

a. Carbon stock: Vegetation data (coverage, biomass, density). Carbon data (carbon stock, sequestration, etc.).
b. Emission Factor: CO2eq Emission Factor of land use change on marine environment.
c. Carbon Inventory: Total emission and emission reduction
d. Reporting obligation: UNFCCC, IPCC, SDGs, e.g., National Determined Contribution (NDC)

These principles are highlighted for calculating carbon emission reduction by the seagrass that is described in Figure below.

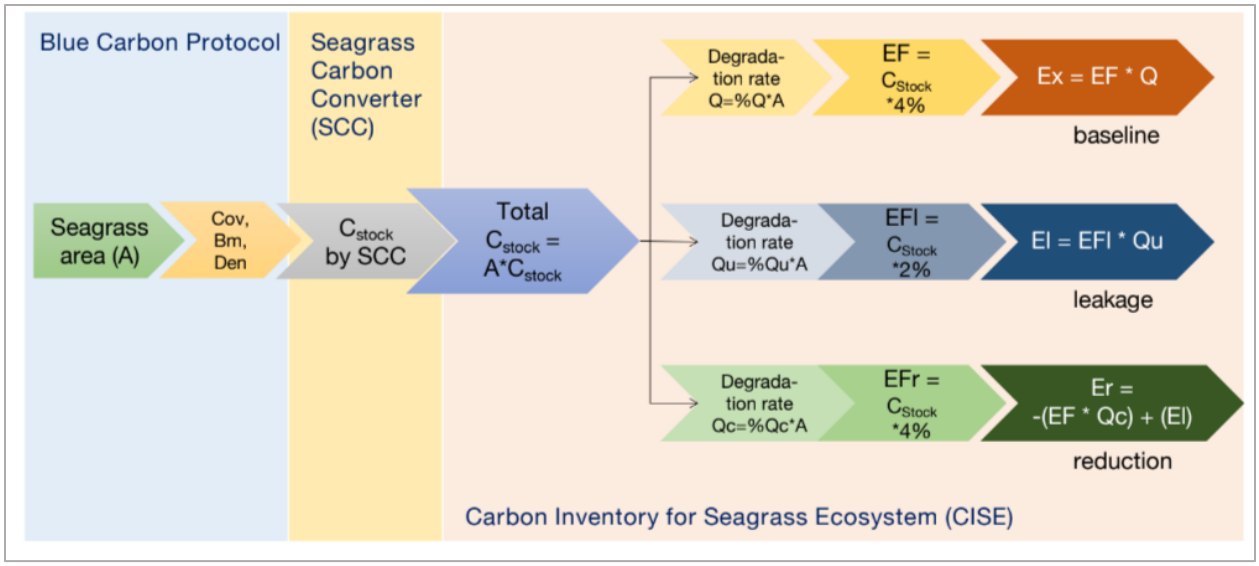


Figure 8. The Calculation of Carbon Emission Reduction by Seagrass (Wahyudi, 2022)

There are essential key points from Dr. Aan J. Wahyudi related to carbon emission by the seagrass:

a. The carbon emission rate of converted/degraded seagrass areas is 0.55 to 1.09 tC/ha/yr or 2%–4% per year of initial carbon stock (Lovelock et al., 2017).
b. Tropical areas such as Indonesia can apply a 4% per year of initial carbon stock.
c. A maximum rate of 2% per year may be applied for EF of conservation activities.

In terms of Indonesia, the carbon emissions reduction by the seagrass are exampled below; and in addition to that, Figure 9 depicts the emissions factors for seagrass ecosystem of each province in Indonesia.

- North Maluku province has the widest seagrass area but only 5% of this is the conserved area.
- DKI Jakarta province has the highest percentage of its conserved seagrass within area.
- Emission reduction at the year 2020 ranged 0.03–1.02 tC/yr (with leakage) or 0.05–2.04 tC/yr (without leakage).
- The percentage of emission reduction among the five provinces ranged from 0.75% to 11.3%.
- About 9.03 tC/yr emission from seagrass ecosystems in Jakarta will decrease by up to 8.01 tC/yr.

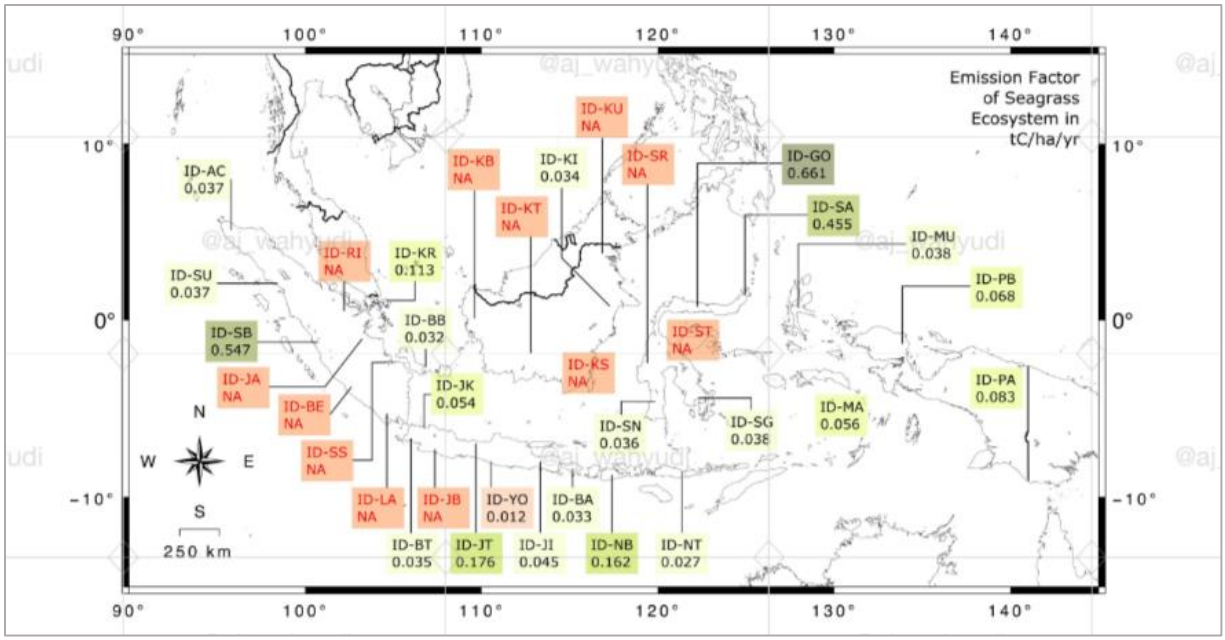


Figure 10. Emission factors for seagrass ecosystem of each province in Indonesia (tC/ha/yr) (Wahyudi & Febriani, 2021)

An Ocean-based climate action was proposed by Dr. Aan J. Wahyudi that serves for the blue carbon for climate mitigation. It is stated that the potential emission reduction will be going down to 11%, of which 8% from mangrove and 3% from seagrass that involves institutions such as BRIN, Ministry for the Forestry and Environment (KLHK), Ministry for Small Islands and Fisheries (KKP), and National Planning Agency (Bappenas) as shown in Figure 11 below.

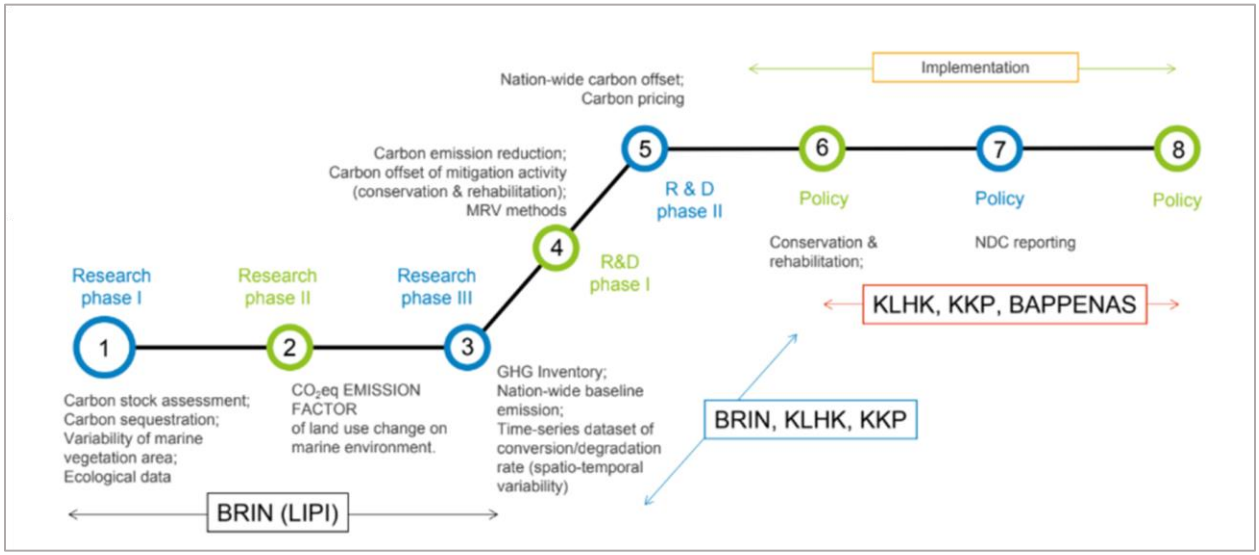


Figure 11. Ocean-based Climate Action: Blue Carbon for Climate Change Mitigation (Wahyudi, 2022)

An interesting and innovation discovery was as well proposed during Dr. Aan J. Wahyudi presentation that illustrated a Mobile-OS-based application for seagrass carbon inventory, which is available to download at ANDROID based application. A further reading for future reference was suggested, namely BLUE CARBON IN SEAGRASS ECOSYSTEM: Guideline for the Assessment of Carbon Stock and Sequestration in Southeast Asia written by Susi Rahmawati, Udhi E. Hernawan, Kathryn McMahon, Bayu Prayudha, Hanif B. Prayitno, A'an J. Wahyudi, Mat Vanderklift (Editors), November 17, 2019, UGM PRESS.

To sum up, the key messages from the role of blue carbon in coastal ecosystem are comprised from the following:
In terms of the role of Blue Carbon or Biological Carbon captured by coastal-marine organisms through photosynthetic processes plays a very important role in sequestering carbon. The Blue ecosystem consists of three main ecosystems; Mangroves, Seagrass, which are available in Indonesia, and Salt Marshes. Those three ecosystems have the least area extension, but they have carbon storage capacity is the highest. If the habitat is destroyed, it releases carbon/play as a carbon source. Blue Carbon needs thus to be optimized to use in the NDC scheme.

In terms of the contribution of the seagrass in Coastal Ecosystem for Blue Carbon, it has raised question such as: how much of seagrass conservation level that can contribute to NDC? Opportunity for action as solution of Climate Change could opt coastal and marine ecosystem and carbon storage in the seabed. There are 13 species of seagrass. Indonesia seagrass habitat is generally in moderate condition; therefore, the seagrass may store carbon deep in sediment. If the vegetation is degraded, then carbon is emitted. Therefore, the key is thus to conserve the seagrass in the long run.

The Role of Blue Carbon in Marine Ecosystem

The third session of the symposium focuses on the role of Blue Carbon in marine ecosystem. The speakers for this session were Professor Catherine E. Lovelock from School of Biological Sciences, The University of Queensland, and Dr. Frida Sidik from BRIN.

Prof. Catherine Lovelock was focusing on mammals and predators in supporting carbon stocks in blue carbon ecosystems. In Australia, blue carbon accounting method has been developed. It focuses on high level organic carbons stored in marine ecosystem to achieve GHG reduction, especially from loss and degradation and enhance CO2 capture through conservation and restoration of coastal wetlands. The method is measured as Australian Carbon Credit Units (ACCU), and one of the applications is for a government-led project on coastal wetland restoration through tidal restoration. The project comprises of BAU (business as usual), project implementation, monitoring and verification, and opportunities mapping (such as biophysical characteristics, financial benefits, regulation, biodiversity, coastal protection). Such project can be applied in Indonesia as well, as the blue carbon method development is incentivizing restoration projects; development of monitoring and verification technologies; development of capacity in science, policy, coastal engineering, conservation, etc.; Assessments of opportunity – with a growing sophisticated view of enablers and impediments (e.g. justice, role of

biodiversity, land-use, land tenure, culture, finances); and Reporting on multiple ecosystem services (government and private sector). When Prof. Catherine was stating about biodiversity; she meant that it comprises such as the following:

- Conservation and restoration of blue carbon ecosystems can: Enhance biodiversity (increasing the value of blue carbon projects) May reduce biodiversity if habitats are lost (e.g. freshwater ecosystems).
- Top predators are important for maintaining blue carbon ecosystems: Links to other habitats (e.g., pelagic) are important Marine Protected Areas are critical.

A framework for conservation and restoration of blue carbon ecosystems was also proposed by Prof. Catherine Lovelock and colleagues recently as illustrated in Figure 12.

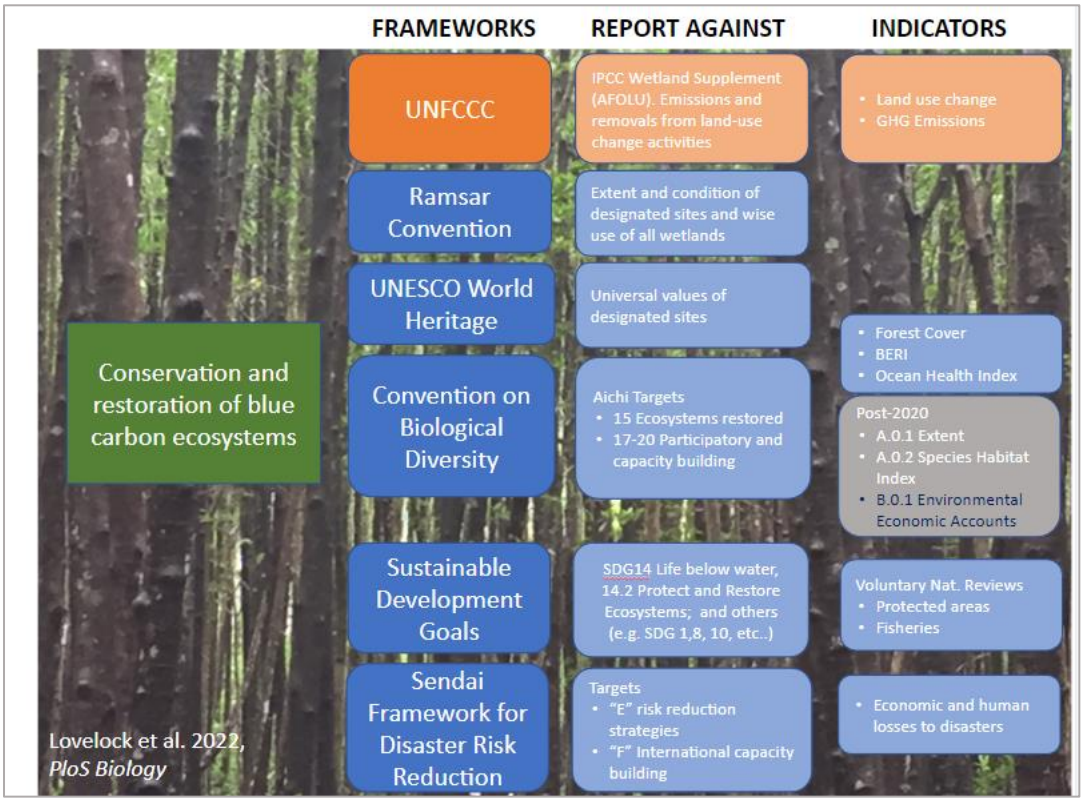


Figure 12. A Conservation and Restoration of Blue Carbon Ecosystems (Lovelock et al., 2020)

Dr. Frida Sidik focuses on the role of sea level rise to mangrove forests and its impacts for blue carbon. Indonesia, as the country with largest mangrove area (such as in Papua, Papua Barat, Riau and Kalimantan), has the potential for CO2 storage around 950 ton per hectare CO2e. The growth of mangrove in these areas are influenced by sea level that is controlled by tidal range. This is because the tidal hydrology influence sediment delivery and re-suspended materials in mangrove forest. One case study is from *Perancak,* Bali Mangrove Forest. The study includes spatial analysis, geomorphological data,

and productivity to measure the response of mangrove to sea level change. In addition to mangrove response, the study also records sediment accumulation rate, where planted and non-planted mangrove can be differentiated. The study found that more than half of mangrove forest are located in area of tidal range from 2-4 m (mesotidal), where 15% are located with high and sustained sediment supply, 8% of mangroves are located in small tidal range. The study concluded that the impact of sea level change and coastal landscape evolution on carbon sequestration is a model on mangrove response to changes in sea level (carbon climate feedback effect) through the paleo-record. Understanding of interactions of mangrove and sea level are important as the growth of mangrove are influenced by sea level. Therefore, this may have implication on mangrove restoration, rehabilitation and appropriate approach will result in climate change mitigation benefit.

It is utmost crucial in assessing the vulnerability of mangroves to sea level rise in the context of tidal range and surface elevation change at different mangrove biophysical typologies. More than half of mangrove forests in Indonesia are located in the areas with tidal range of 2-4 m (mesotidal); whereby 15% of mangrove forests are at locations with high and sustained sediment supply (i.e. deltas) and high tidal range coastline. About 8% of mangroves (273,521 ha) are in areas with smaller tidal range. It is worth to be noted that Mangroves along microtidal coastlines (smaller lateral extent) are generally at greater risk from the impact of sea level rise (Ellison, 2015; Nicholls et al, 1999, Semeniuk, 1994; Ward et al., 2016). The paleo-record (analysis of stratigraphic deposits in sedimentary archives) has the purpose to model the mangrove response to changes in sea level (carbon–climate feedback effect). The effects can increase the rate of organic-carbon burial in coastal wetlands and to diminish it over time due to wetland submergence and coastal erosion (DeLaune et al, 2012, Kirwan & Mudd, 2012, Rogers et al, 2019), Below is the exemplary for the above explanation.

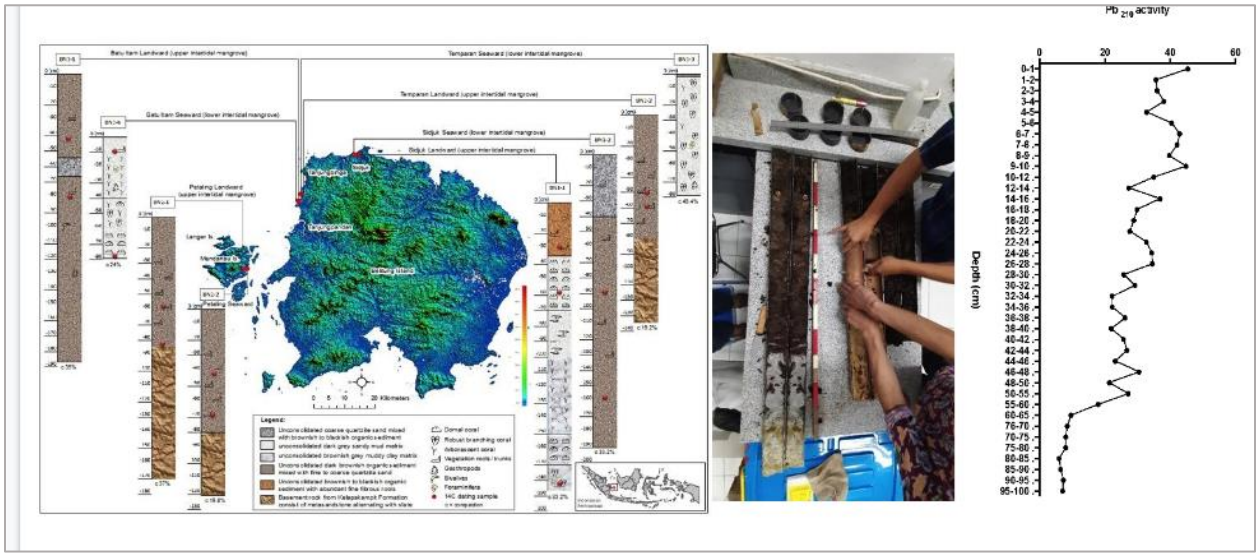


Figure 13. The Paleo-Record (analysis of stratigraphic deposits in sedimentary archives) (Sidik, 2022)

This session concluded that blue carbon in marine ecosystem has significant roles in nature-based solutions for climate change mitigation, addressing biodiversity crisis, adaptation to sea level rise, and justice in adaptation, which should be achieved with avoidance of greenwashing.

Important take-out points from the symposium that are essential on the role of blue carbon by marine ecosystem in terms of the development of a blue carbon accounting method and understanding opportunities for uptake, taken as example in Australia; are the following: Australia has developed blue carbon accounting methods through government-led projects to achieve blue carbon goal; that may be replicated in Indonesia. The goal is to reduce GHG emissions from loss and degradation and enhance CO2 capture through conservation and restoration of coastal wetlands. Followingly, the progress in achieving the blue carbon goals can help in many efforts' climate change mitigation, addressing the biodiversity crisis, adaptation to sea level rise, and justice in adaptation, to be achieved without greenwashing. In terms of the contribution of mangrove and sea level rise in marine ecosystem for blue carbon, it can be stated that the coastal environments are influenced by sea level and sediment supply and understanding the interactions of mangrove and sea level are important as the growth of mangrove are influenced by sea level. Therefore, it may have implications on mangrove restoration, rehabilitation, and thus, appropriate approach will result in climate change mitigation benefit.

The Linkage of Biodiversity and Role of Blue Carbon in Coastal and Marine Ecosystem, Challenges, and Way Forward

In the light of Governing Climate Targets, Energy Transition, and Environmental Protection as stated as the results of G20 policy recommendations; blue carbon in coastal and marine ecosystems play crucial role as nature-based solutions for emissions reduction, disaster risk reduction and socio-economic benefit provision. It is urged that nations within the G20 should revitalize legal and policy frameworks to conserve and restore marine biodiversity and coastal ecosystems; encourage effective community and indigenous peoples engagement and incentive-based approaches that ensure tenurial security and equitable benefit sharing in blue carbon, marine, and coastal ecosystem governance; recognize the critical role of collaborative science and innovation in bolstering science-based decision making for ocean-based climate actions, including on marine protected area (MPA) management; promote a blended-finance approach to close the financing gap on marine and coastal conservation to deliver on the United Nations Sustainable Development Goals (SDGs) and other climate targets. Ultimately, the G20 nations, including Indonesia should strengthen cooperation and collaboration on committing to treaties and regulations that promote ocean-based climate change mitigation and resilience, including on marine protected area (MPA) management.

However, challenges exist in reaching the ideal state above. Analysis in the G20 Policy Brief of Governing Blue Carbon, Coastal and Marine Ecosystems for Climate Change Mitigation and Resilience, has revealed that the ocean has great potential to enhance global efforts to reduce greenhouse gas emissions and strengthen climate resilience. Blue Carbon Environments (BCE) such as mangrove1 and seagrass might store 10 times more carbon per hectare than terrestrial ecosystems (McLeod et al., 2011). Ocean-based mitigation approaches have the potential to cut global greenhouse gas (GHG) emissions by approximately 4 billion tonnes of carbon dioxide equivalent (CO2e) per year in 2030 and more than 11 billion tonnes per year in 2050, compared to anticipated BAU emissions. These reductions are more than the emissions from all present coal-fired power facilities globally (Hoegh-Guldberg et al., 2019 in Januar et al., 2022). Therefore, it requires action on five key challenges highlighted in the policy brief, as follow:
The first challenge is a vague legal and policy framework in protecting marine and coastal ecosystems. Despite continuing marine habitat loss and degradation driven by anthropogenic pressures, most countries have not specifically classified BCE and coastal ecosystems as fragile and threatened ecosystems in their legal framework. Moreover, overlapping authorities in coastal management and unclear institutional arrangements challenge protection, monitoring, and restoration efforts.

The second challenge is restrictive BCE and coastal ecosystems governance. The absence of indigenous people and local communities' (IPLCs) genuine participation in decision-making is still prevalent. Therefore, inclusive governance, which robustly incorporates the voices of different stakeholders particularly IPLCs, and gives them a lead role in governance, is essential. As critical actors, IPLCs should be ensured of their rights – especially their rights to receive equitable benefits from environmental protection efforts and tenurial security. Unresolved tenurial issues can hamper communities in protecting BCE and coastal ecosystems from gaining financial benefits.

The third challenge is limited application of data and science to support policymaking processes on BCE, coastal ecosystems and marine biodiversity. There are limited available data related to governing marine and coastal ecosystems – such as on the health of BCE and coastal ecosystems, impact and management of protected areas, and fisheries monitoring. Greater availability of reliable data, and data-driven innovative solutions, are necessary to strengthen policies towards achieving Aichi Biodiversity targets and United Nations Sustainable Development Goals (SDGs).

The fourth challenge is Insufficient capital mobilization to support marine and coastal management. Resource availability is key to fully realizing the oceans as nature-based solutions for climate change. However, the amount of marine and coastal conservation finance available is currently insufficient to efficiently protect and restore the ecosystems. Countries must explore innovative financial mechanisms and enhance the adoption of available funding.

The fifth and last challenge is limited international collaboration to achieve ocean-based climate change mitigation and resilience at scale. The global governance of sustainable fisheries, marine protection, and blue carbon, requires global cooperation. From promoting BCE as a nature-based solution (NbS) to climate change, up to ensuring sustainable fisheries production – countries need to find mechanisms of collaboration for advancing these measures.

Therefore, as an attempt to moving forward and addressing above challenges, this symposium is trying to grasp on the issues and highlight necessary action that should be taken. It is agreed that the Blue Carbon Ecosystem/Environment (BCE) is vital to achieving the targeted NDC and REDD+ and it is not arguable that conserving blue carbon ecosystems, both coastal and marine ecosystems are utmost needed. To appropriately conserve those ecosystems; policy, regulation, and operational guidance should be at hand. In mobilizing these, the blue carbon needs to be considered foremost for beneficiaries for vulnerable ones if NbS is applied, as well as the need for incentivizing scheme for blue carbon implementation for global, as well as regional participation and collaboration.

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Annex: The Program Agenda

International Symposium Program
Role of Blue Carbon in REDD+ and NDC
(19 December 2022, 12:00 PM – 18:00 PM (GMT+7)

Online via Zoom for International Speakers & Participants - Offline for National Speakers, Invited Participants and Organizers

*) Livestream at Venue: Universitas Pertamina, Simprug Area, Jakarta

Time	Session	Speaker
12:00 – 13:00 PM	Luncheon & Networking	
13:00 – 13:15 PM	▪ Opening the virtual room ▪ Online registration for the participants	
13:15 – 13:30 PM	**Opening Remarks & Opening the International Symposium**	**Prof. IGN WIRATMAJA PUJA, PhD.** Rector of Universitas Pertamina **AGUS MASHUD S. ASNGARI** President Director of Pertamina Foundation
13:30 – 13:45 PM	**Group Photo**	
13:45 – 14:00 PM	**Bridging to the next session**	
14:00 – 14:30 PM	**Status and Way Forward of Regional Biodiversity Policy**	**Speaker:** **Mr. Carlo Carlos** (ASEAN Centre for Biodiversity) *Status and Ways Forward of Regional Biodiversity Policy* **Moderator:** **Yulius Bulo** (Director of Operation of Pertamina Foundation)
14:30 – 15:45 PM	**Role of Blue Carbon by Coastal Ecosystem**	**Moderator:** **Prof. Rudianto Amirta,S. Hut.,MP.** (Dean of Faculty of Forestry, Universitas Mulawarman, Indonesia) **Speakers:** **Dr. Novi Susetyo Adi**

Time	Session	Speaker
		(Directorate of Coastal and Small Islands Utilization, Ministry of Marine Affairs and Fisheries Republik Indonesia) *Nature-based and Nature-Climate solutions (NBS/NCS) from coastal ecosystem perspective* **Dr. Aan J. Wahyudi** (BRIN, Indonesia) *Carbon-Offset Potential from Tropical Seagrass Conservation in Indonesia*
15:45 – 16:15 PM	**Coffee Break**	Music/Cultural Performance by Universitas Pertamina
16:15 – 17:30 PM	**Role Of Blue Carbon By Marine Ecosystem**	**Moderator:** **Dr. Eng. Nova Ulhasanah** (Universitas Pertamina) **Speakers:** **Professor Catherine E. Lovelock** (School Of Biological Sciences, The University of Queensland) *The Development of a Blue Carbon Accounting Method and Understanding Opportunities For Uptake in Australia* **Dr. Frida Sidik** (BRIN, Indonesia) *The Role of Sea Level Rise to Mangrove Forests and Its Impacts for Blue Carbon (Mangrove, Sea level rise and Blue Carbon)*
17:30 – 18:00 PM	**Synthesis on the Role of Blue Carbon by Coastal & Marine Ecosystem, Wrap Up and Closing**	**Yulius Bulo, Prof. Rudianto Amirta,S. Hut.,MP., and Dr. Eng. Nova Ulhasanah** (Moderators)
18:00 PM	**Dinner and Networking**	